PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

WALLACE CREEK BASIN
WALLACE CREEK DAM
CLINTON, MONTANA
MT-1158

PREPARED FOR:

THE HONORABLE TED SCHWINDEN
GOVERNOR OF THE STATE OF MONTANA

MR. JAMES FLANSBURG
(OWNER AND OPERATOR)

PREPARED BY:

MORRISON - MAIERLE, INC.
CONSULTING ENGINEERS

APRIL, 1981

U.S. ARMY
CORPS OF ENGINEERS
Seattle
DISTRICT

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EXECUTIVE SUMMARY

Under contract with the State of Montana Department of Natural Resources and Conservation and with representation from Department of Natural Resources and Conservation and Mr. James Flansburg, Morrison-Maierle, Inc. inspected Wallace Creek Dam on 17 July, 1980 under the authority of Public Law 92-367. The dam is located on Wallace Creek, a tributary to the Clark Fork in Missoula County about two miles east of Clinton and 17 miles southeast of Missoula, Montana.

This report was compiled from information obtained during onsite inspection and analysis of available information. Findings were compared with engineering criteria that are currently accepted by most private and public agencies engaged in dam design, construction, and operation.

FINDINGS AND EVALUATION

Wallace Creek Dam is owned and operated by Mr. James Flansburg. The reservoir is used solely for storage of irrigation waters. The 29-foot high earth and rockfill dam, constructed without engineering investigation or design, impounds 134 acre-feet of water at the dam crest, assumed elevation 3898.4 feet National Geodetic Vertical Datum (NGVD). All elevations used in this report are based on assumed elevation 3896.0 feet NGVD at the top of the concrete weir in the spillway.

Based on criteria in U.S. Army Corps of Engineers Recommended Guidelines for Safety Inspection of Dams (Reference 1), the project is small in size. The dam is located such that its failure could endanger many lives and cause excessive economic loss. Downstream from the dam there are approximately seven residences, Interstate Highway 90, a railroad and portions of the town of Clinton which would be affected by a sudden dam failure. No dam breach analysis or routing of a dam breach flood was made for the downstream area and the conclusions on probable damage are based on a brief field visit and engineering judgement.

The project is classified as having a high downstream hazard potential (Category 1). Inspection criteria (Reference 1) recommends that a small size project with a high downstream hazard potential be capable of safely handling a flood the size of one-half the probable maximum flood (PMF) to a full PMF. The PMF is the flood expected from the most severe combination of meteorologic and hydrologic conditions that are reasonably possible in the region. Based on the finding of this inspection, the full PMF is recommended as the spillway design flood (SDF) because of the high risk to more than two inhabitable structures located downstream.

An estimated thunderstorm PMF was developed for the 5.54-square-mile drainage basin. The PMF resulting from a 6-hour thunderstorm has an estimated volume of 2,350 acre-feet and a peak flow of 37,600 cfs The emergency spillway has a maximum discharge capacity of 173 cfs with the culverts open and the reservoir at assumed top of dam, elevation 3898.4 feet NGVD. The routing of the PMF was started at the spillway weir crest elevation 3896.0 and indicates that the dam is overtopped when approximately

1.5 percent of the total flood volume enters the reservoir. A flood with a hydrograph having ordinates corresponding to one percent of the PMF hydrograph ordinates is just controlled by the dam. Larger floods would overtop it. The dam is constructed of materials that would quickly erode and rapidly fail when overtopped by floodwaters. Such failure would endanger lives along Wallace Creek and in Clinton and cause extensive damage to primary highways, railroads, farm land and buildings.

There are no piezometers or other instrumentation in the dam and available information is not adequate to determine embankment stability.

Based on the field inspection and study of hydrologic data, it was determined that Wallace Creek Dam does not conform to the inspection guidelines with respect to discharge and/or storage capacities to safely handle the recommended spillway design flood (SDF). The spillway capacity is seriously inadequate. Because the dam is incapable of controlling one-half the PMF without overtopping and causing the dam to fail, Wallace Creek Dam is considered unsafe (nonemergency) until recommended actions are completed.

RECOMMENDATIONS

A downstream warning system for use in the event of possible dam overtopping or structural failure needs to be developed and immediately placed in action. The low level outlet conduit and intake structure should be inspected for evidence of leakage through the grout seal and seepage along the conduit. Remove trees and brush on the embankment slopes and backfill and compact disturbed areas. Inspect the downstream slope, toe and abutment areas periodically for changes in seepage conditions.

Conduct more detailed hydrologic and hydraulic routing studies to better determine the downstream hazard and required spillway capacity and modify the dam as studies indicate. Investigate the observed seepage and determine the phreatic surface by the installation and monitoring of piezometers. Conduct studies, including field exploration and laboratory testing of foundation and embankment soils, to evaluate embankment stability and modify the project as studies indicate. Inspect the dam at no less than five-year intervals by geotechnical engineers experienced in dam design and construction.

Prior to performing engineering studies and remedial construction, coordinate the work with the State of Montana, Departmnt of Natural Resources and Conservation, to insure compliance with all pertinent laws and regulations.

MONTANA
RODGER C.
FOSTER
3654 E
REGISTERED
PROFESSIONAL ENGINEER

Rodger C. Foster

RODGER C. FOSTER
PROFESSIONAL ENGINEER

Wallace Creek Dam
Pertinent Data

1. GENERAL

Federal ID No.	MT-1158
Owner	Jim Flansburg
Operator	Jim Flansburg
Date Constructed	1922, modified about 1968
Purpose	Irrigation
Location	Section 24, T12N, R17W Latitude 46°46'08" Longitude 113°40'02"
County, State	Missoula County, Montana
Watershed	Wallace Creek
Size	Small
Downstream Hazard Potential	Category 1 (High)
USGS Quadrangle	Clinton, Montana

2. RESERVOIR

Surface Area at Spillway Weir Crest (Elev. 3896.0 ft. NGVD)	13 acres
Drainage Area	5.54 square miles
Storage at Spillway Weir Crest (Elev. 3896.0 ft. NGVD)	100 acre-feet
Storage at Dam Crest (Elevation 3898.4 ft. NGVD)	134 acre-feet
Surcharge Storage	34 acre-feet
Reservoir Elevation (7/17/80)	3887.6 feet NGVD

3. SPILLWAY

Type	Uncontrolled, unlined chute
Bottom Width	10 feet

3. SPILLWAY - Continued

Weir Crest Elevation	3896.0 feet NGVD
Capacity with Reservoir at Dam Crest (Elev. 3898.4 ft. NGVD) (culverts open)	173 cfs

4. OUTLET WORKS

Conduit	12-inch diameter steel pipe inside an 18-inch diameter concrete pipe
Conduit length	Approximately two miles to end of pipe. Length through embankment unknown.
Gate	Slide gate, size unknown, located on upstream face of dam. Gate stem extends along upstream slope to dam crest.
Capacity with Reservoir at Dam Crest	4 cfs

5. DAM

Type	Rockfill core with earth shell and earthfill dike
Length	720 feet
Crest Width	11 to 13 feet
Crest Elevation	Varies from 3898.4 to 3899.7 feet NGVD
Hydraulic Height (Crest to Toe)	29 feet
Upstream Slope	1 V on 2.25 H
Downstream Slope	1 V on 1.75 H

Chapter 1

BACKGROUND

1.1 INTRODUCTION

1.1.1 Authority and Scope

This report summarizes the Phase I inspection and evaluation of the Wallace Creek Dam owned by Mr. Jim Flansburg.

The National Dam Inspection Act, Public Law 92-367 dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to conduct safety inspections of non-federally owned dams throughout the United States. Pursuant to that authority, the Chief of Engineers issued "Recommended Guidelines for Safety Inspection of Dams" in Appendix D, Volume 1 of the U.S. Army Corps of Engineers' report to the United States Congress on "National Program of Inspection of Dams" in May 1975.

The recommended guidelines were prepared with the help of engineers and scientists highly experienced in dam safety from many federal and state agencies, professional engineering organizations and private engineering consulting firms. Consequently, the evaluation criteria presented in the guidelines represent the comprehensive consensus of the engineering community.

Where necessary, the guidelines recommend a two-phased study procedure for investigation and evaluation of existing dam conditions so deficiencies and hazardous conditions can be readily identified and corrected. The Phase I study is

(1) a limited investigation to assess the general safety condition of the dam.

(2) based upon an evaluation of the available data and a visual inspection.

(3) performed to determine if any needed emergency measures and/or additional studies, investigations, and analyses are necessary or warranted.

(4) not intended to include extensive explorations and analyses or to provide detailed alternative correction recommendations.

The Phase II investigation includes all additional studies necessary to evaluate the safety of the dam. Included in Phase II, as required, should be additional visual inspections, measurements, foundation exploration and testing, material testing, hydraulic and hydrologic analyses, and structural stability analyses.

The authority for the Corps of Engineers to participate in the inspection of non-federally-owned dams is limited to Phase I investigations with the exception of situations of extreme emergency. In these cases, the Corps may proceed with Phase II studies but only to the extent needed to answer serious questions relating to dam safety that cannot be answered otherwise. The two phases of investigation outlined above are intended only to evaluate project safety and do not encompass in scope the engineering required to perform design or corrective modification work.

Recommendations contained in this report may be for either Phase II safety analyses or detailed design study for corrective work.

The responsibility for implementation of these Phase I recommendations rests with the dam owner and the State of Montana. It should be noted that nothing contained in the National Dam Inspection Act, and no action or failure to act under this Act shall be construed (1) to create liability in the United States or its officers or employees for the recovery of damage caused by such action or failure to act or (2) to relieve an owner or operator of a dam of the legal duties, obligations, or liabilities incident to the ownership or operation of the dam.

1.1.2 Purpose

The purpose of the inspection and evaluation is to identify conditions that threaten public safety, so that they may be corrected in a timely manner by non-federal interests.

1.1.3 Inspection

The findings and recommendations in this report are based on a brief visual inspection of the project and discussions with the owner. Inspection procedures and criteria are those established by the Recommended Guidelines for Safety Inspection of Dams (Reference 1).

Personnel present during the inspection included:

Art Taylor	State of Montana, Department of Natural Resources and Conservation
Rodger Foster	Team Leader, Morrison-Maierle, Inc., Water Resource Engineer
Mike Kaczmarek	Engineering Geologist, Morrison-Maierle, Inc.

Mr. Jim Flansburg accompanied the inspection team to the dam site and provided introductory information. He did not remain for the inspection. An exit interview was held with Mr. Flansburg upon the completion of the on-site inspection.

Additional Morrison-Maierle personnel who contributed to the evaluation are:

Bill Keith	Structural Engineer
Ken Salo	Hydrologist/Hydraulics Engineer.

This report has been reviewed by representatives of the Montana Department of Natural Resources and Conservation and the owner, whose written responses are included in the Appendix.

1.2 DESCRIPTION OF PROJECT

1.2.1 General

Wallace Creek Dam is located on Wallace Creek in Missoula County, Montana approximately 17 miles southeast of Missoula and two miles east of Clinton (See Plates 1 and 2). The project's federal identification number is MT-1158. The dam and reservoir are located approximately two miles upstream of Clinton, Montana. The 29-foot high earth and rockfill dam impounds approximately 134 acre-feet at the dam crest, assumed elevation 3898.4 feet NGVD. All elevations used in this report are based on assumed elevation 3896.0 feet for the top of the concrete weir in the spillway chute.

Based on visual reconnaissance and engineering judgement, approximately seven residences, Interstate Highway 90, railroads, farm land, utilities and portions of the town of Clinton would be affected by a sudden breach of Wallace Creek Dam. On the basis of this information and in accordance with recommended guidelines, the dam is classified as small in size and the downstream hazard potential is high (Category 1).

The dam consists of a main embankment about 240 feet long and a dike approximately 10 feet high which extends for an additional 480 feet to the spillway. (See Plate 3).

The 240-foot long, 10-foot wide uncontrolled, unlined spillway chute is located just beyond the south abutment of the dam (Plate 3 and Photos 7, 8, 9, 10, 11).

The low level outlet is located approximately 150 feet from the north abutment (See Plate 3). The present outlet conduit is a 12-inch diameter steel pipe placed inside the original 18-inch diameter concrete outlet pipe and now extends from the inlet structure in the reservoir, through the embankment and approximately two miles downstream where it connects to a sprinkler irrigation system. The flow is controlled by a slide gate of unknown size located in an inlet box in the reservoir. There is also a valve located at the downstream end of the pipe. There is no other outlet from the reservoir.

1.2.2 Regional Geology and Seismicity

The Wallace Creek Dam and Reservoir are in the Northern Rocky Mountains province of Fenneman (Reference 2). The Wallace Creek drainage is in the western portion of the Garnet Range and is almost entirely mountainous. Bedrock consists of quartzite, siltite, argillite, and igneous rocks. Surficial desposits consist chiefly of alluvium in the valleys of rivers and streams and local alluvial fans, colluvial deposits, talus deposits, and landslide deposits. Glacial deposits and sediments of glacial Lake Missoula are present in and near the Garnet Range but do not occur in the Wallace Creek watershed.

The Wallace Creek area of the Garnet Range is centered on a major tectonic feature of western Montana referred to as the Lewis and Clark line. The Lewis and Clark line is a structural lineament defined by diver-

gent tectonic patterns north and south of the feature. The principle feature of the Lewis and Clark line at Wallace Creek is the Clark Fork fault (Reference 4). Nelson and Dobell (1961) describe the Clark Fork fault as a high-angle normal fault with as much as 6,500 vertical feet of displacement in the Bonner quadrangle west of Wallace Creek. Other work (Harrison et al., Reference 6) suggests the Clark Fork fault may be an easternmost manifestation of structural movement along the Hope-Ninemile faults which are major fault systems in western Montana.

The Clark Fork fault in the Wallace Creek drainage is expressed as a wide zone of brecciated rocks that trends directly up the valley floor. The fault is mapped as the Clark Fork breccia zone in this location and the amount of displacement is unknown. The geologic structure north of the breccia zone at Wallace Creek is characterized by north northwest trending folds and thrust faults displaced by younger northwest trending high-angle normal faults. The geologic structure south of the Clark Fork breccia zone is a series of east-west trending, southward dipping thrust faults.

The Wallace Creek Dam is in seismic probability Zone 2 (Reference 1). The seismic probabilities used herein divide the United States into four seismic risk zones based on the record of the severity of ground shaking and the reasonable expectancy of earthquake damage. Seismic probability Zone 2 indicates that earthquakes with potential for moderate damage may occur. Zone 2 corresponds to a potential intensity of VII on the modified Mercalli intensity scale of 1931. In accordance with recommended guidelines (Reference 1), the hazard of seismic loading and resultant embankment shear failure is considered to be negligable in seismic probability Zone 2 provided static stability conditions are satisfactory and conventional safety margins exist.

1.2.3 Site Geology

The right abutment of the Wallace Creek Dam consists of bouldery alluvial fan material from several small coalescing tributaries. The numerous rounded granodiorite boulders in the alluvial fan deposits range in mean dimension from two to five feet. The alluvial fan matrix consists of poorly sorted coarse-grained to conglomeratic silty to clayey granitic sand. The thickness of the alluvial fan deposits is unknown.

The foundation materials at the toe of the alluvial fan deposits consist of a less than 20 feet wide channel of recent alluvium of unknown thickness that forms the modern stream bottom. The poorly exposed alluvium appears to consist of subangular quartzite gravels set in a matrix of poorly sorted sand.

The remainder of the foundation materials and the left abutment consist of stabilized Pleistocene landslide deposits. The landslide occupies about 30 acres in the SE quarter of Section 24 (Plate 7). The landslide is evidently a mudflow deposit and consists of angular quartzite fragments set in a poorly sorted (well graded) matrix of sand silt and clay. Many of the quartzite fragments are highly brecciated, suggesting an origin in the Clark Fork fault zone. The clay content of the mudslide material is estimated at less than 15 percent by field texturing but is sufficient to

contribute to a cohesive, relatively impermeable soil mass with low plasticity. Careful examination of the landslide did not reveal any evidence of recent mass movement or soil creep.

Outcrops present in an erosion channel downstream from the spillway consist of massive granodiorite and a highly altered dacite porphyry dike. The granodiorite is probably an apophysis of the Clinton stock. The granodiorite is present below the land surface of the landslide deposits downstream from the dam axis at depths as shallow as 10 to 15 feet. Neither the granodiorite or the dacite porphyry is sheared or brecciated by faulting. The age of related granodiorite intrusives in the area ranges from about 65 to 85 million years (Reference 7). The presence of unfaulted granodiorite in the fault zone trending through the Wallace Creek Dam and Reservoir indicates that the local portion of the Clark Fork fault zone has not moved at the surface for 65 to 85 million years.

1.2.4 Design and Construction History

The Wallace Creek Dam was built in 1922 reportedly without the benefit of engineering assistance or site investigations. Mr. Flansburg, the present owner, worked on the dam during its construction and was able to describe the construction history.

Prior to 1922 there was a small six-foot high dam at the site. In 1922 the low dam was removed and a timber crib, earth and rock fill dam was constructed to the height of the present dam. The 1922 dam consisted of a timber wall on the downstream face behind which the rock fill was placed. An earth shell was placed on the upstream face which functioned as the impervious membrane. The earth shell was placed by horse-drawn scrapers and compacted by repeated passes of the horses. About 1965, the timber on the downstream face of the dam was removed because of its deteriorated condition and an earth embankment was placed against the rock fill to provide stability. These repairs were made by Lyons Construction Company of Drummond, Montana.

There is no design or construction information available for either the 1922 dam or the repairs made in the 1960's. There is no information on shear strength of foundation or embankment materials and there is no stability analysis on file.

Chapter 2

INSPECTION AND RECORDS EVALUATION

2.1 HYDRAULICS AND STRUCTURES

2.1.1 Spillway

The spillway for Wallace Creek Dam is located in natural ground just beyond the south abutment (See Plate 3 and Photos 7 through 11). The spillway consists of an unlined chute excavated in a heterogeneous landslide mass consisting of angular quartzite fragments set in a sandy matrix (Plate 5). There is a control structure located 225 feet downstream of the spillway entrance which consists of four 24-inch diameter by 15-foot long corrugated metal pipe (CMP) culverts set in concrete (Photo 8). The assumed elevation of the top of the culverts is 3895.2 feet NGVD and the flow line of the culverts is at elevation 3893.2 feet which is 5.2 feet lower than the minimum elevation of the dam crest. The chute is approximately 225 feet long from the entrance at the reservoir to the culverts with an adverse slope. The cross-section is generally trapezoidal but has a rectangular bottom section 10 feet wide and eight feet deep (Plate 5). Downstream of the culverts, the discharge channel is on a very steep slope of approximately 32 percent and is highly erodible. The concrete weir-culvert section was probably installed to check the headward erosion in the channel. Immediately downstream of the culverts, car bodies and large rock and debris have been placed to reduce erosion. Erosion in the discharge channel or the spillway chute poses no threat to the stability of the dam. The discharge channel joins the Wallace Creek channel approximately 0.25 miles downstream of the dam. The downstream reaches of the discharge channel have eroded to bedrock and erosion in this area would not be expected to continue.

The discharge rating for the spillway was developed by assuming that critical depth occurs at the downstream end of the 15-foot long culvert section. This was verified by backwater computations which were made using HEC-2 (Reference 8) beginning in the discharge channel below the culverts and extending upstream through the spillway to the reservoir. Assuming a Manning's "n" value of 0.05, and that the culverts remain open, the maximum spillway discharge capacity with the reservoir at the minimum dam crest elevation 3898.4 feet NGVD was estimated to be 173 cfs. Blockage of the culverts would reduce the spillway capacity about 30 cfs. Because the culverts could become blocked with debris, and/or an antecedent storm preceding the PMF could raise the reservoir elevation above the culverts, the elevation for the uncontrolled concrete spillway weir crest (3896.0 feet NGVD) was assumed as the spillway crest when routing the PMF through the reservoir.

The spillway chute from the reservoir to the culvert section is in fair condition with a heavy growth of weeds in the channel (Photo 9). In the left bank area (facing downstream) there is a moderately thick stand of fir trees and on the right bank is a dike with some brush and a few small trees on it extending from the dam. The shoreline of the reservoir is heavily timbered and brushy with quite a lot of debris in the near shore area particularly at the spillway entrance (Photo 7). There is no log boom

or other means of controlling debris at the spillway and the potential for debris clogging a portion of the spillway chute during large flows is high. According to the owner the spillway is used frequently.

2.1.2 Outlet

Prior to the completion of the repair work on the dam in the 1960's, the low level outlet consisted of an 18-inch diameter concrete pipe which extended through the embankment and was controlled by a slide gate mounted in an inlet structure at the toe of the upstream slope. The gate was operated by a wheel mounted at the crest of the dam with the gate stem extending down the upstream slope of the dam.

At the time of the repair work a 12-inch diameter steel pipe was placed inside the 18-inch diameter concrete pipe. The steel pipe extended through the concrete pipe to a point immediately downstream of the gate at the inlet structure. Grout was placed by hand around the steel pipe and inside the concrete pipe at the upstream end for as far as could be reached by hand to seal off all flow except through the steel pipe. The gate control remained on the concrete pipe (See Plate 4). The intake structure could not be inspected due to the reservoir level and the outlet conduit could only be inspected where it exited the toe of the downstream slope (Photo 13). At the point of exit the steel pipe was observed exiting from inside the concrete pipe. The steel pipe continues downstream for about one-half mile where it necks down to a 10-inch diameter steel pipe and continues downstream for another 1½ miles. The steel pipe ends near the owner's house approximately 400 feet lower in elevation than the intake structure at the dam. The pipe is also controlled by a valve at the downstream end and operates as a pressure conduit.

The slide gate at the dam is operated by means of a wheel which can be attached to the gate stem at the crest of the dam. The gate was not operated during the inspection.

The discharge capacity of the low level outlet has a negligible effect on the hydrologic routing evaluation of the reservoir. The maximum discharge capacity of the outlet with the reservoir at the crest of the spillway (3896.0 feet) would be approximately 4 cfs or 1800 gallons per minute.

2.1.3 Freeboard

Because the dam overtops during the recommended spillway design flood (SDF: see paragraph 2.2.4), it has no freeboard. The vertical distance between the low point on the dam and the reservoir level at the time of the inspection was 10.9 feet. The assumed spillway crest (elevation 3896.0 feet) is 2.4 feet below the low point on the dam crest. The actual flow line of the spillway chute is five feet below the low point of the dam. The crest of the dam and dike as determined by survey varies 1.5 feet over its 720-foot length with the lowest elevation (3898.4 feet) located at the outlet conduit (station 1+50). The prevailing winds of the region are from the west and southwest which would be directed away from the dam. For winds directed toward the dam from the east, the effective fetch for wind-generated waves is about 1000 feet and wave runup on the embankment is estimated to be less than two feet. Although the dam will be overtopped during the SDF, the vertical distance between the low point of the dam

crest and the normal reservoir level (3893.2) is adequate to prevent overtopping of the embankment by wind-generated waves during times of normal pool operation.

2.2 HYDROLOGY, CLIMATOLOGY, AND PHYSIOGRAPHY

2.2.1 General

The climate of the area is continental in nature, characterized by warm summers and cold winters. The nearest climatological station is at Potomac (3,620 feet NGVD), about 10 miles northeast of the basin. The Potomac station has 16 years of record which is incomplete. A climatological station at Drummond, (Drummond Aviation, elevation 3,943 feet) 29 miles to the east also has 16 years of record. The nearest station with long record is Missoula WSO AP (5745) with 43 years of record at an elevation of 3,190 feet NGVD. Mean annual precipitation at Missoula airport is 13.34 inches with 28% falling in the heaviest precipitation months of May (1.72 inches) and June (1.99 inches). Mean February precipitation is 0.74 inches and mean July precipitation is 0.92 inches. Mean annual precipitation at the center of Wallace Creek basin is approximately 23 inches. Mean annual temperature at Missoula airport is 43.7° Fahrenheit (F), mean January temperature is 20.8°F, and mean July temperature is 66.6°F. May and June temperatures average 52.2°F and 58.9°F, respectively. Temperatures in the Wallace Creek basin would be expected to average two to three degrees cooler than Missoula. Summer temperatures rarely exceed 100°F, and winter temperatures can reach 25 to 30 degrees below zero F.

The drainage area for Wallace Creek Dam is 5.54 square miles and is generally oval shaped with the longest stream length oriented in the direction of the minor axis of the oval. The basin is actually divided into three sub-basins of relatively equal size, which feed the reservoir directly (See Plate 2). The basin is located on the western exposure of the Garnet Range approximately 60 miles west of the Continental Divide. The terrain is steep and mountainous with basin elevations varying from 3,896 feet NGVD to 6,340 feet NGVD in a stream length of three miles. Approximately 85% of the basin is forested and 15% is open grassland. The heavier forest cover is at the lower elevations with the sparser growth and open areas occuring at the higher elevations. There are no USGS stream gages in the basin; however, gages are located on the Clark Fork, Rock Creek and other tributaries to the Clark Fork. A gaged tributary to the Clark Fork near Drummond (station 12324700) has a 4.7 square mile drainage and would be comparable to Wallace Creek basin.

2.2.2 Reservoir Storage and Spillway Discharge

The reservoir has a surface area of 13 acres and a storage of 100 acre-feet at the spillway crest elevation 3,896.0 feet NGVD. Approximately 34 acre-feet of surcharge storage is available in the reservoir between the spillway crest and the dam crest elevation of 3,898.4 feet. The spillway discharge with the reservoir at the dam crest is 173 cfs, or about 14 acre-feet per hour.

2.2.3 Estimated Probable Maximum Flood

The probable maximum flood (PMF) is the flood expected from the most severe combination of critical meterologic and hydrologic conditions that is reasonably possible in the region. An estimate of the PMF was made during this dam safety analysis and was routed through the reservoir.

The probable maximum precipitation (PMP) was developed using procedure contained in the U.S. Weather Bureau's Hydrometerological Report No. 43 (Reference 9) as updated by U.S. Weather Bureau memorandum dated September 20, 1967 (Reference 10). The PMP produces 8.65 inches of rain in six hours (thunderstorm) and 11.8 inches in 72 hours (general storm). A minimum loss rate of 0.15 inches per hour was assumed to represent the hydrologic class B soils in the basin and minimum infiltration conditions due to saturated ground. Baseflow was considered to be 20 cfs and snowmelt was not used in the computation. The storm which produces the PMF would be a 6-hour thunderstorm during the period July to August.

A triangular unit hydrograph for a 6-minute rainfall duration was developed for the 5.54 square mile drainage using procedures contained in Design of Small Dams (Reference 11). The Soil Conservation Service method of developing a curvilinear fit of the triangular unit hydrograph was used. The hourly increments of the PMP were arranged in a critical time sequence as illustrated in HMR No. 43, page 204, figure 6-1e (Reference 9). The 6-minute increments from the two hours of greatest precipitation were rearranged in the reverse order of the unit hydrograph to produce the greatest possible peak. The PMP was applied to the unit hydrograph by means of the computer program HEC-1 (Reference 12). This estimate of the PMP produced a flood with a peak flow of 37,600 cfs and a volume of 2,350 acre-feet.

2.2.4 Flood Routing

Routing of the probable maximum flood through Wallace Creek reservoir was performed using the computer program HEC-1 Flood Hydrograph Package (Reference 12). The reservoir was assumed to be at the elevation of the spillway weir crest (3,896.0 feet NGVD) at the beginning of the PMF. This condition could result from an antecedent storm preceding the PMF, blockage of the spillway CMP culverts or both. The low level outlet works was not considered in the analysis because its capacity is insignificant compared to the flow of the PMF. The routing shows that the dam will be overtopped during the PMF when approximately 1.5 percent of the total flood volume (36 acre-feet) enters the reservoir.

Routings were made of lesser hypothetical floods than the PMF to determine the magnitude of floods the dam can contain. The hypothetical hydrographs were obtained by applying percentages to the PMF hydrograph ordinates. A flood with a hydrograph having ordinates corresponding to one percent of the PMF ordinates is just controlled by the dam. Larger floods would overtop the dam.

2.3 GEOTECHNICAL EVALUATION

The information presented in this geotechnical evaluation is based solely on observations and measurements conducted during the field inspection

of July 17, 1980 and conversations with Mr. Flansburg, who helped construct the dam in 1922 and who owns it. Geotechnical data per se has not been collected for the dam and appurtenant structures or for any stage of the design, construction, or operation of the dam.

2.3.1 Dam

The Wallace Creek Dam consists of an earth and rock fill dam section 240 feet long and 29 feet high with a connecting earthfill dike about 10 feet high which extends another 500 feet. The crest varies from 11 to 13 feet wide. The downstream face of the embankment is somewhat irregular due to modifications but has an average slope of about 1V on 1.75H. The exposed portion of the upstream face is concave and averages about 1V on 2.25H. As described by the owner the original 1922 embankment consisted of a log crib against which rock fill (granodiorite boulders from the right abutment area) was placed on the upstream side in the vicinity of stations 0+00 to 2+40 (Plate 4). The crib and rock fill extended to an approximate elevation of 3890.0 feet. The rock fill was covered by earth fill borrowed from the landslide deposits on the south abutment and placed by horse drawn scraper. The earth fill was placed on top and on the upstream side of the rockfill. The log crib on the downstream side of the embankment remained exposed. The earth fill comprised the remainder of the embankment above elevation 3890.0 feet including the dike.

Some time in the mid- to late 1960's, the deteriorated log crib on the downstream face was removed by means of a bulldozer and additional earth fill was placed on the downstream face of the embankment below the elevation of the crib. The embankment above the crib was not damaged. The source of the new fill was the landslide deposited on the south abutment and the new fill was placed without compaction by bulldozer. A prominent bench remains on the downstream face of the dam at elevation 3883.0 feet.

The composite earth and rock fill embankment does not exhibit any evidence of differential settlement, misalignment, erosion, rodent burrows or embankment failure. The upstream and downstream faces of the embankment are heavily vegetated with large bushes and mature trees and could be described as "forested" in most spots. The upstream face is not protected by riprap or other selected material but it is not wave eroded.

2.3.2 Foundation Conditions, Seepage, and Drainage

The foundation under the north end of the dam consists of the bouldery alluvial fan material that comprises the north abutment. The embankment foundation from station 0+00 to station 1+90 consists of recent alluvium of unknown thickness. The remainder of the embankment is founded on stabilized landslide deposits from station 1+90 to the spillway at station 7+40. The owner states that no core trench and little or no surface preparation was used in the foundation area. A pre-1922 dam about six feet high was leveled out prior to construction of the 1922 embankment on the same site. An erosion channel downstream from the spillway outlet exposes outcrops of granodiorite and heavily altered dacite porphyry bedrocks within 10 to 15 vertical feet of the existing land surface of the landslide deposits in the borrow area.

The dense vegetation on the downstream face of the dam obscured any evidence of a phreatic line or wetting front based on vegetational zoning. Inspection revealed a small amount of seepage discharging from the area between the 12-inch pipe and the 18-inch pipe and from beneath the 18-inch concrete outlet pipe. The amount of seepage from each location could not be distinquished but total seepage was estimated at one to two gallons per minute (gpm) and was free-flowing, clear water. There was no evidence of piping or erosion at the outlet pipe area. The alluvial gravel in the original stream channel 10 to 12 feet downstream from the toe of the fill was dry. The pool elevation at the time of inspection was 3887.6 feet.

A free-flowing spring discharging 50 to 100 gpm was observed in the spillway channel about 100 feet downstream from the culvert section. The highest appearance of water in the channel below the spillway on July 17, 1980 was at an elevation of 3873.0 feet, about the same elevation as the top of the massive granodioriate bedrock which outcrops further downstream in the channel. A second seep, with approximately the same flow, surfaces on the bedrock of the spillway erosion channel about 150 feet further downstream from the first seep. Evidently, seepage is moving either through the base of the landslide material on top of the bedrock or through a rubble zone or fractured weathering zone on the bedrock. The bedrock apparently controls the elevation of seepage discharge at the base of the landslide material. The owner states that seepage losses make it impossible to maintain the level of stored water in the reservoir during periods of low inflow.

There is no evidence of any formal drainage system within the embankment.

2.3.3 Stability

There is no stability analysis on file and the available information is insufficient for an evaluation of embankment stability.

There is no reliable information on strength and seepage characteristics of the embankment or foundation materials; there are no piezometers installed in the dam and the location of the seepage line is unknown.

2.4 PROJECT OPERATION AND MAINTENANCE

2.4.1 Dam

There is no periodic maintenance plan for the dam and there has been no major maintenance performed on the main embankment or the dike portion of the dam since it was constructed except for the removal of the timber crib in the 1960's. Minor maintenance has been performed on an as-needed basis. The placement of the concrete weir and culverts in the spillway and the use of car bodies and miscellaneous debris in the downstream section of the spillway demonstrates an attempt to control headward erosion of the spillway channel. There has also been minor maintenance performed such as periodic dressing of the road along the dam crest and clearing the spillway chute and outlet works of debris. Mr. Flansburg attempted to locate and seal the seepage areas but was unable to do so.

2.4.2 Reservoir

The reservoir is operated with the low level outlet which can be controlled either at the dam or at the end of the 12-inch line near Mr. Flansburg's home at the mouth of Wallace Creek canyon. The reservoir is used for irrigation and is normally quite low at the end of the irrigation season. The reservoir is allowed to fill through the winter and spring. Mr. Flansburg stated that as the reservoir fills he tries to prevent water from spilling by regulating outflow with the low level outlet. According to Mr. Flansburg, a few homes built near the channel downstream would be flooded if he allowed high flows to pass over the spillway. High flows were experienced in the region in 1975 and according to a description of the event by the owner, the flood was routed without substantial discharge over the spillway by using the outlet and available reservoir storage. Mr. Flansburg commented that the inflow from one basin during that event washed out a 48-inch diameter culvert upstream of the reservoir.

The owner is concerned about the regulation of the reservoir to prevent flooding but feels the capacity of the outlet works provides adequate regulatory capability.

2.4.3 Warning Plan

There is no formal warning plan in use in the event of impending dam failure.

Chapter 3
FINDINGS AND RECOMMENDATIONS

3.1 FINDINGS

Visual inspection of the dam, supplemented by analysis of the project in terms of the recommended guidelines, resulted in the following findings.

3.1.1 Size, Hazard Classification, and Safety Evaluation

Wallace Creek Dam impounds 134 acre-feet of water with the reservoir at the crest of the dam. In accordance with the recommended guidelines (Reference 1), the project is classified as small in size and has a high (category 1) downstream hazard potential rating. The recommended spillway design flood (SDF) for this project is a full PMF. The project can safely handle only 1.5 percent of the PMF. Because the project is incapable of controlling one-half the PMF without over-topping and causing the dam to fail, Wallace Creek Dam is considered unsafe (non-emergency) until the recommended actions (section 3.2) are completed.

3.1.2 Embankment Dam

Wallace Creek Dam consists of a 29-foot high main embankment section and a connecting dike section approximately 10 feet high. The main embankment was constructed originally as a timber crib, rockfill dam with an earth embankment comprising the top 10 feet and the upstream face of the dam.

The deteriorating timber crib was replaced in the 1960's with an earth embankment on the downstream face for stability. A visual inspection revealed no longitudinal or transverse cracking and there was no serious erosion on the embankment or at the abutment contacts or the toe. The downstream slope of the embankment is heavily vegetated with mature trees and brush. The downstream slope is somewhat irregular due to the construction of modifications but no irregularities were noted which would indicate slope instability. The upstream slope is also heavily vegetated with trees and brush but appears to be uniform with no serious irregularities.

The elevation difference between the embankment crest and the pool level at the time of the inspection was 10.9 feet which corresponds to a reservoir elevation of 3887.5 feet NGVD. This is 8.5 feet below the spillway weir elevation. There is no riprap protection on the upstream slope nor is there any wave erosion. Prevailing winds are away from the dam which would keep wave action on the embankment to a minimum. Freeboard during normal operations would be sufficient to prevent wind-generated waves from overtopping the dam crest.

A seep or spring flow, estimated to be 50 to 100 gallons per minute, emerges from the bedrock in the spillway channel about 100 feet downstream of the dam. A second seep emerges similarly about 150 feet further downstream. The seeps are apparently in the foundation material or fractured bedrock and are clean and free-flowing. There is no indication of erosion or piping at the seep areas.

An estimated one to two gallons per minute was observed seeping through and under the 18-inch diameter concrete outlet pipe. The water was clear and there was no noticable erosion at the outlet.

The seepage conditions have not apparently affected the embankment. Sufficient information is not currently available for an evaluation of the embankment stability.

3.1.3 Spillway and Reservoir Capacity

The reservoir has a surface area of about 13 acres and a storage of 100 acre-feet at the spillway crest, elevation 3896.0 feet NGVD. Approximately 34 acre-feet of surcharge is available in the reservoir between the spillway crest and the dam crest elevation 3899.0 feet NGVD. The maximum discharge of the spillway with the reservoir at the dam crest is 173 cfs.

3.1.4 Outlet Works

The outlet works are operated regularly by the owner and reportedly are in good operating condition. The outlet conduit is a combination of 10-and 12-inch diameter steel pipe which extends from the dam to the mouth of Wallace Creek Canyon, about two miles downstream. The outlet pipe could only be inspected at the point of exit at the toe of the embankment and appeared to be in good condition. The steel pipe has been placed inside the original 18-inch diameter concrete pipe. The concrete pipe could not be inspected except at the point of exit because of the placement of the steel pipe. The intake structure could not be inspected because of the reservoir level. In addition to the outlet gate, the 12-inch line can be controlled with a gate valve at the end of the pipe two miles downstream. The reservoir is operated for irrigation water supply with the primary withdrawal demands occuring in the summer. The reservoir is allowed to fill the remainder of the year. The owner normally maintains outlet control with the valve at the end of the pipe near his house and leaves the gate at the dam open. There is some use of the water throughout the year to fill the fire truck and for other miscellaneous needs. The owner does provide some flood regulation with the reservoir in the spring using the low level outlet. There is no routine maintenance program for the dam and the embankment is heavily overgrown with trees and brush. There is no record of any previous inspections of the dam and there is no formal downstream warning plan for use in the event of impending failure.

3.2 RECOMMENDATIONS

The findings suggest that high priority be given the following recommendations:

1. Immediately develop, implement, and periodically test an emergency warning plan for use in the event of impending dam overtopping or structural failure.

2. Remove the trees, root systems, and brush from the embankment, toe areas, and abutments. Backfill and compact all depressions.

3. Inspect the low-level outlet gate, conduit and intake structure and repair it if required.

4. Develop an interim reservoir operating and maintenance plan to minimize risk until improvements are made.

5. Keep the spillway channel free of debris and place a log boom at the spillway inlet to prevent debris from clogging the channel.

The above items will not make the project safe, but they will reduce risk to life and property while the following recommended actions are being taken.

6. Make an assessment of the phreatic surface through the dam by drilling and installing piezometers. Perform and place on file a slope stability analysis of the embankment. The analysis should be conducted by a qualified geotechnical engineer and be based on actual phreatic surface and strength characteristics as determined from piezometer drilling and sampling. Modify the dam section as required for stability.

7. Conduct more detailed hydrologic and hydraulic routing studies to better determine the downstream hazard and required spillway capacity, and modify the project as studies indicate.

8. Engineers experienced in dam design and construction should inspect Wallace Creek Dam at least once every five years.

Prior to performing engineering studies and remedial construction, coordinate the work with the State of Montana, Department of Natural Resources and Conservation, to insure compliance with all pertinent laws and regulations.

REFERENCES

1. U.S. Army Corps of Engineers, Office of the Chief of Engineers Report to the U.S. Congress, 1975 National Program of Inspection of Dams, Vol. 1, Appendix D, Recommended Guidelines for Safety Inspection of Dams, Washington, D.C., Department of the Army.

2. Fenneman, N.M., 1931, Physiography of Western United States: New York, McGraw - Hill Book Co., 534 p.

3. American Commission on Stratigraphic Nomenclature, 1961, Code of Stratigraphic Nomenclature: American Assoc. Petroleum Geologists Bull., V. 45, p. 645-665.

4. Nelson, W.H. and Dobell, J.P., 1961, Geology of the Bonner Quadrangle, Mont.: U.S. Geol. Survey Bull. 1111-F, p. 189-235.

5. Hintzman, D.E., 1964, Geology and Ore Deposits of the Clinton Mining District: Montana Bur. Mines and Geology Bull. 40, 38 p.

6. Harrison, J.E., Kleinhopf, M.D., and Obradovich, J.D., 1972, Tectonic Events at the Intersection between the Hope Fault and the Purcell Trench, Northern Idaho: U.S. Geol. Survey Prof. Paper 719, 24 p.

7. Robinson, G.D., Klepper, M.R., and Obradovich, J.D., 1968, Overlapping Plutonism, Volcanism, and Tectonism in the Boulder Batholith Region Western Montana, in, Coats R.A., Hay R.L., and Anderson, C.A. eds., Studies in Volcanology - A Memoir in Honor of Howel Williams: Geol. Soc. America Mem. 116, p. 557-576.

8. U.S. Department of the Army, Corps of Engineers Hydrologic Engineering Center, 1976, HEC-2 Water Surface Profiles, Generalized Computer Program Users Manual with Supplement.

9. U.S. Weather Bureau, 1966, Hydrometeorological Report No. 43, Probable Maximum Precipitation, Northwest States, Washington, D.C.

10. Hydrometeorological Branch, U.S. Weather Bureau Office of Hydrology, 1967, Memorandum: Probable Maximum Thunderstorm Rain for the Columbia River Basin East of the Cascade Ridge.

11. U.S. Department of Interior, Design of Small Dams, 3rd edition, Bureau of Reclamation.

12. U.S. Department of the Army, 1973, Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations, Hydrologic Engineering Center, Corps of Engineers, Davis, California, 93 pp.

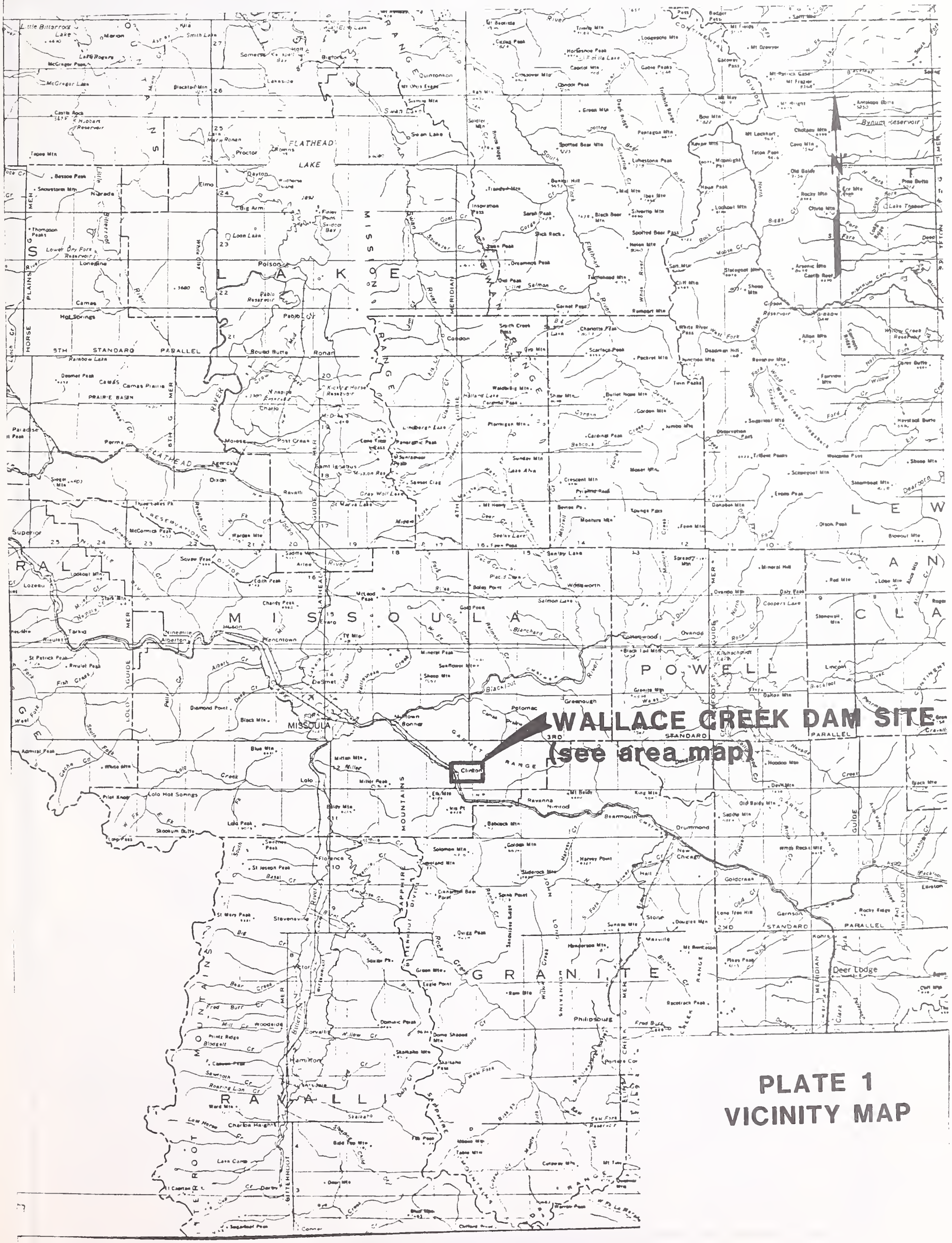
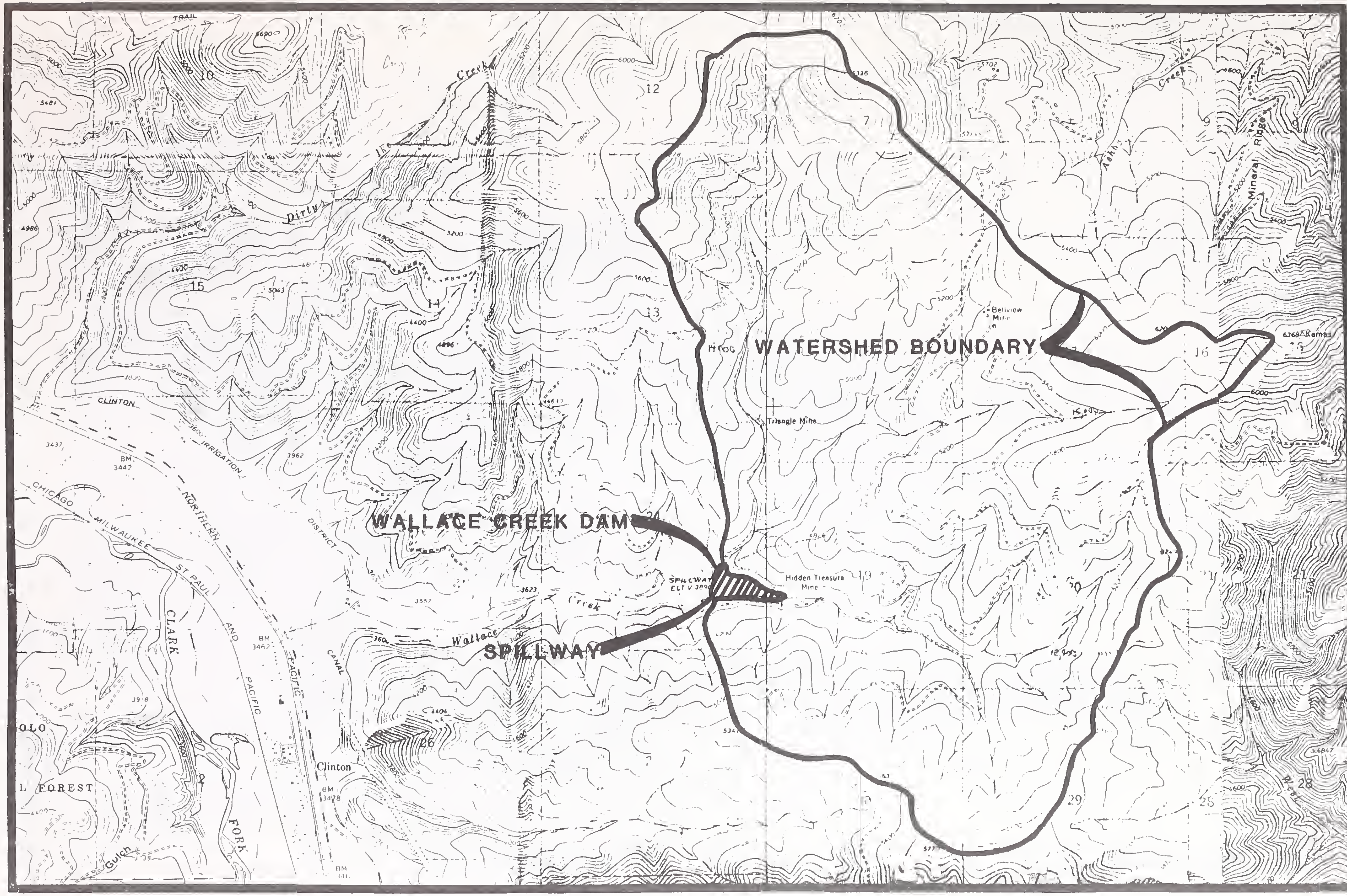


PLATE 1
VICINITY MAP



Source of Base: USGS Quadrangles, CLINTON (1965) and MINERAL RIDGE (1965).

1 0 1

Scale in MILES

AREA MAP

PLATE 2

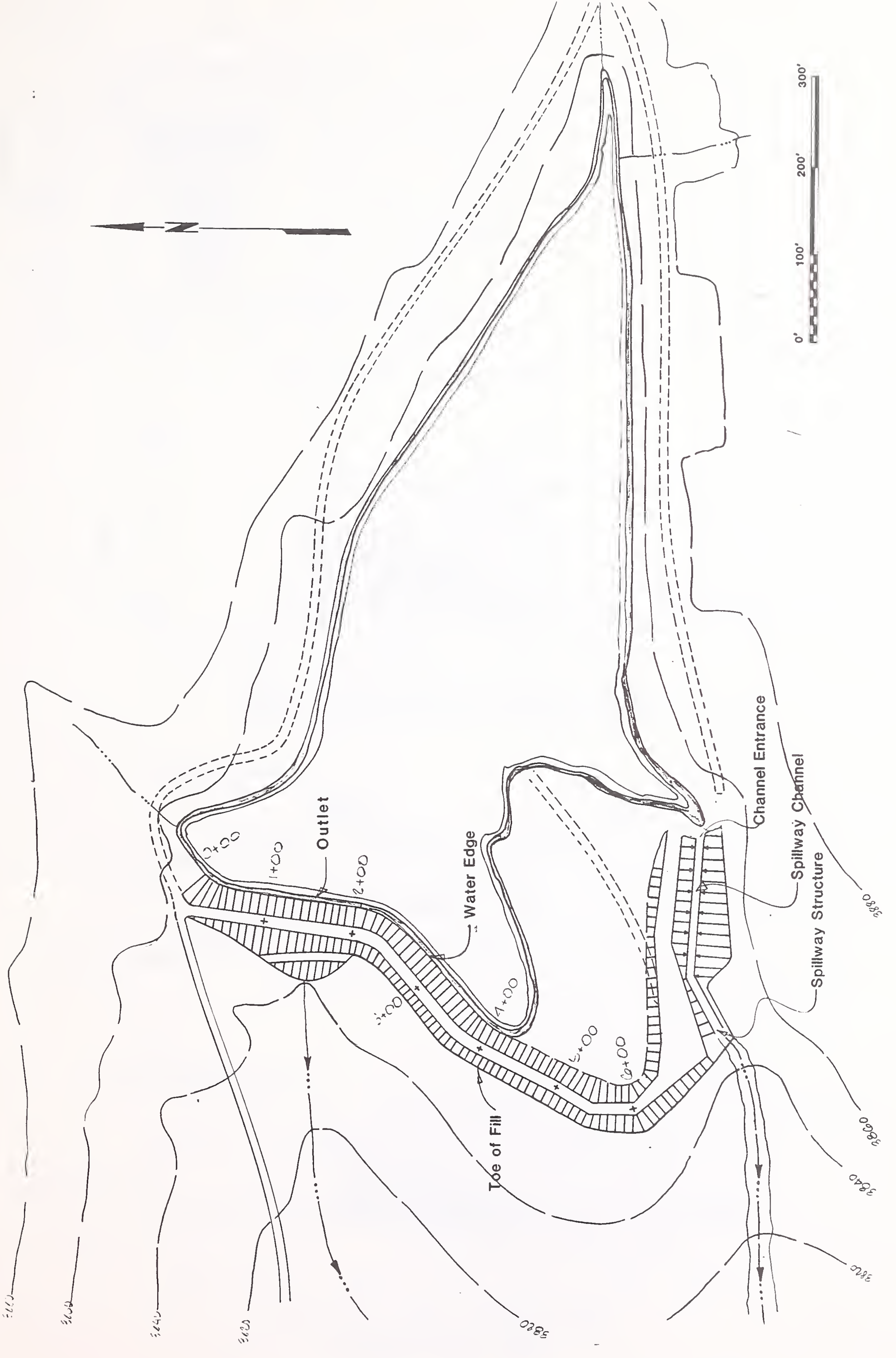


PLATE 3
WALLACE CREEK DAM SITE PLAN

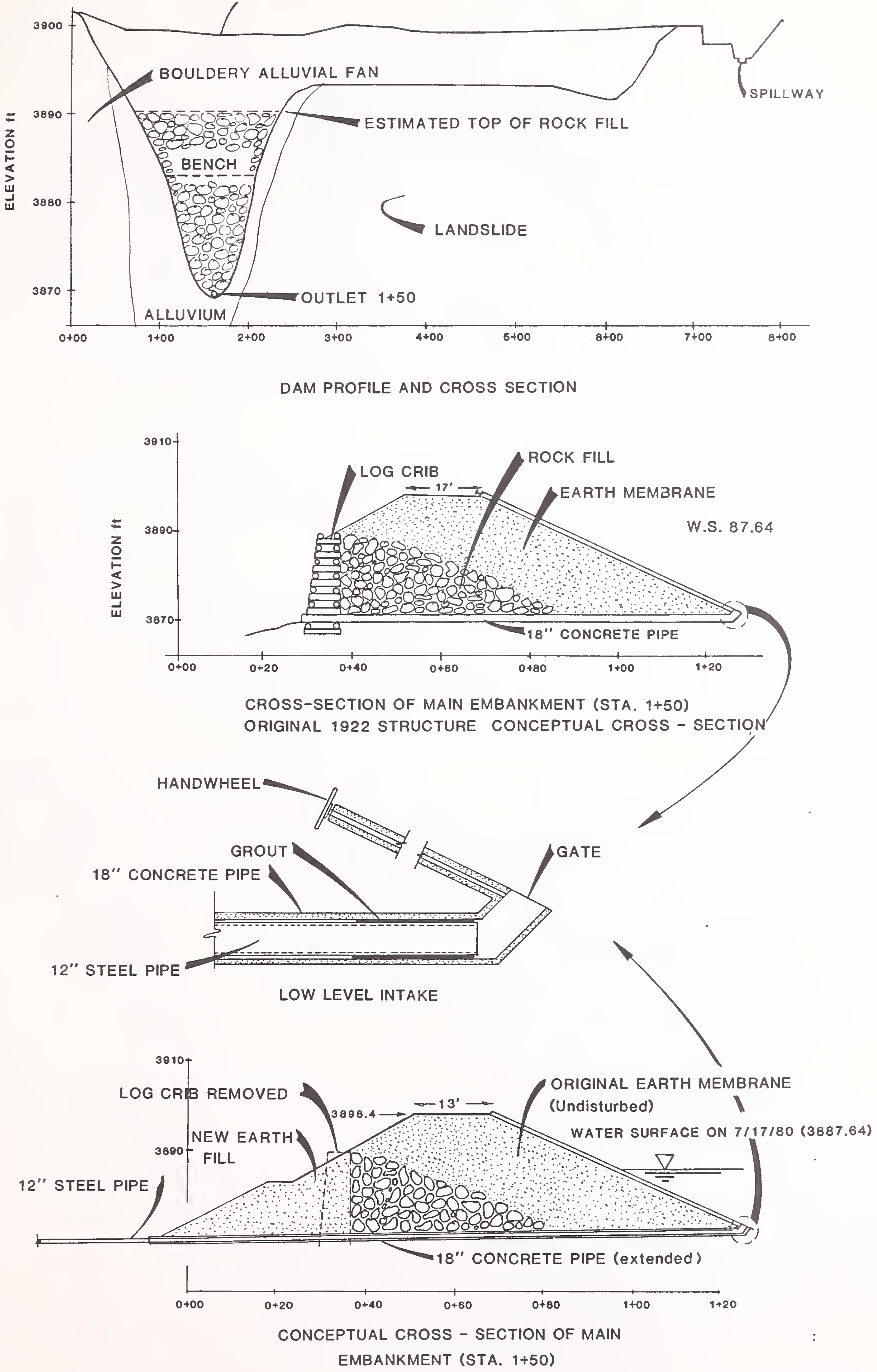
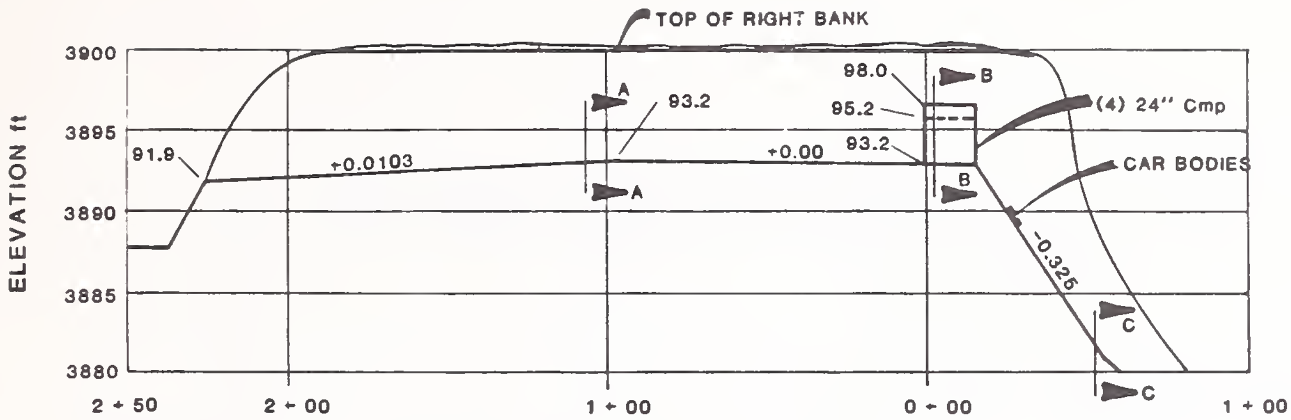
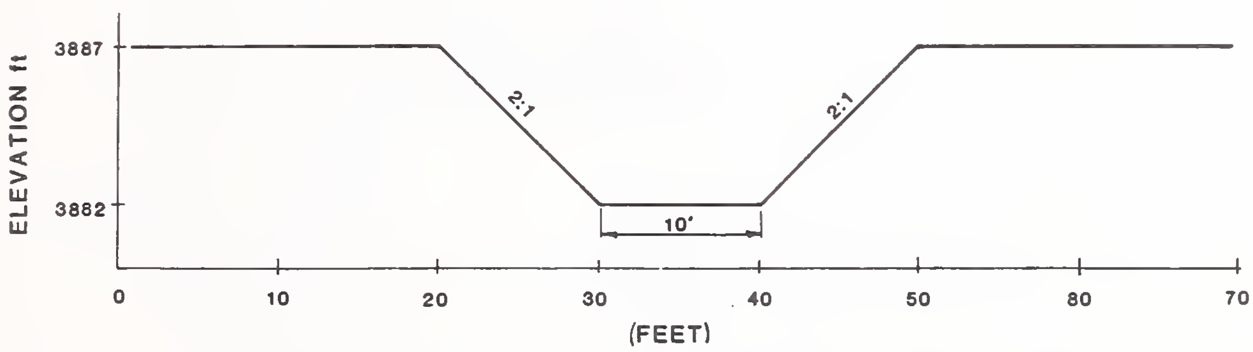


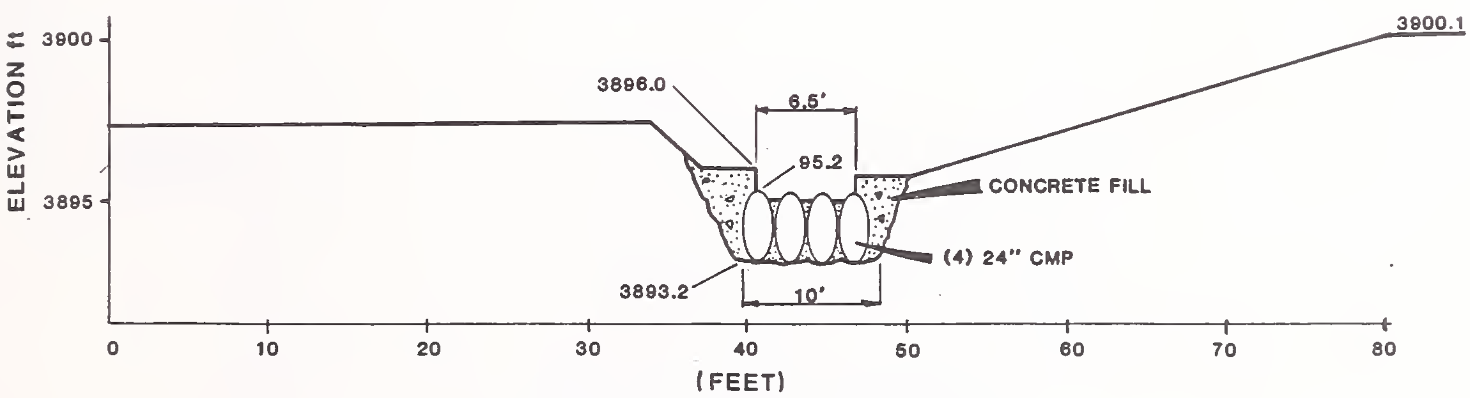
PLATE 4
DAM PROFILE AND CROSS-SECTION



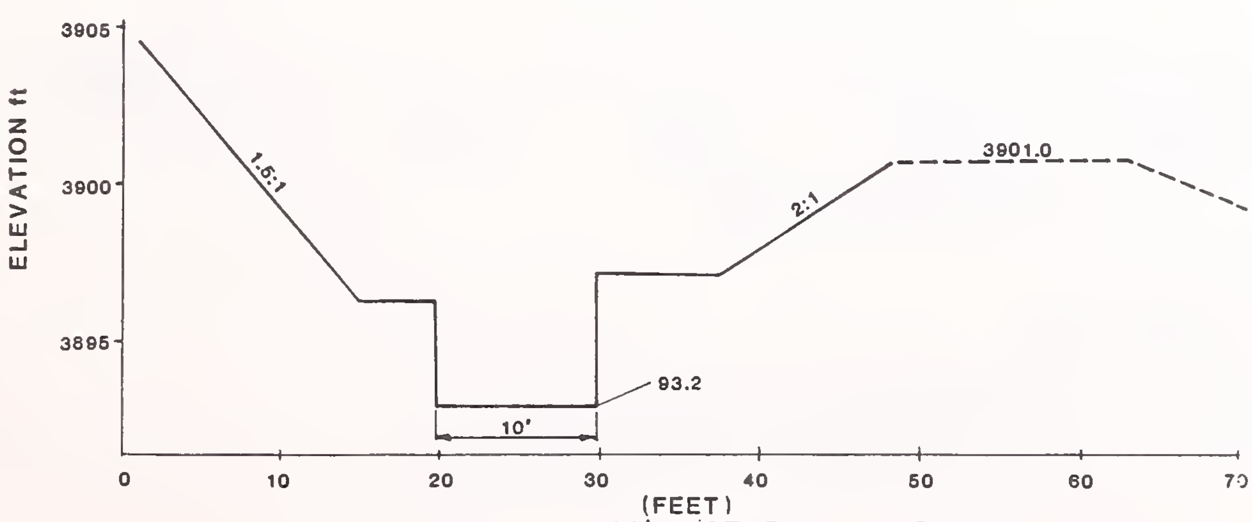
PROFILE OF SPILLWAY STRUCTURE



CROSS SECTION C, 55' DOWNSTREAM OF SPILLWAY WEIR



CROSS SECTION B AT SPILLWAY



CROSS SECTION A, 100' UPSTREAM OF SPILLWAY

PLATE 5

SPILLWAY PROFILE AND CROSS-SECTION

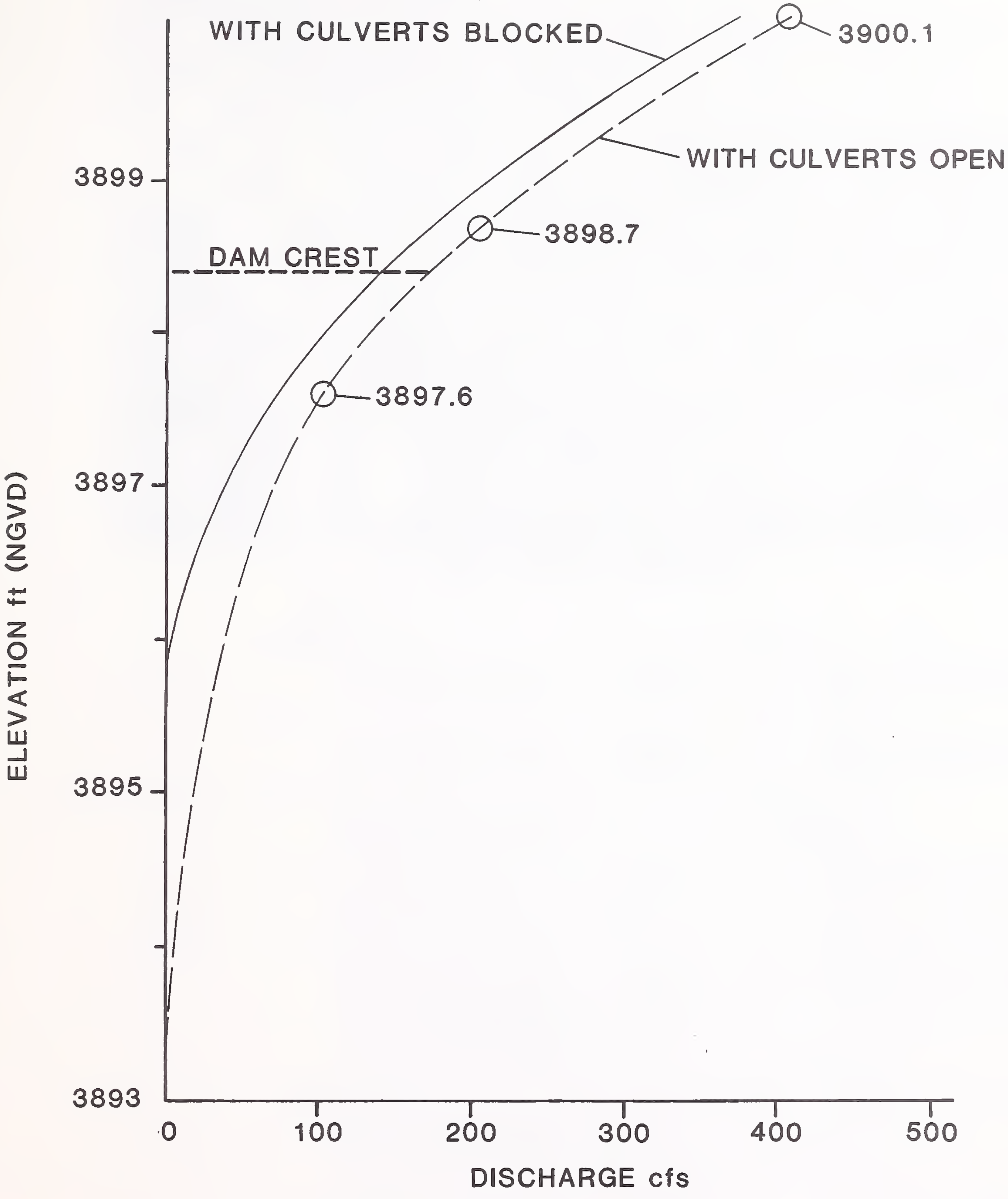
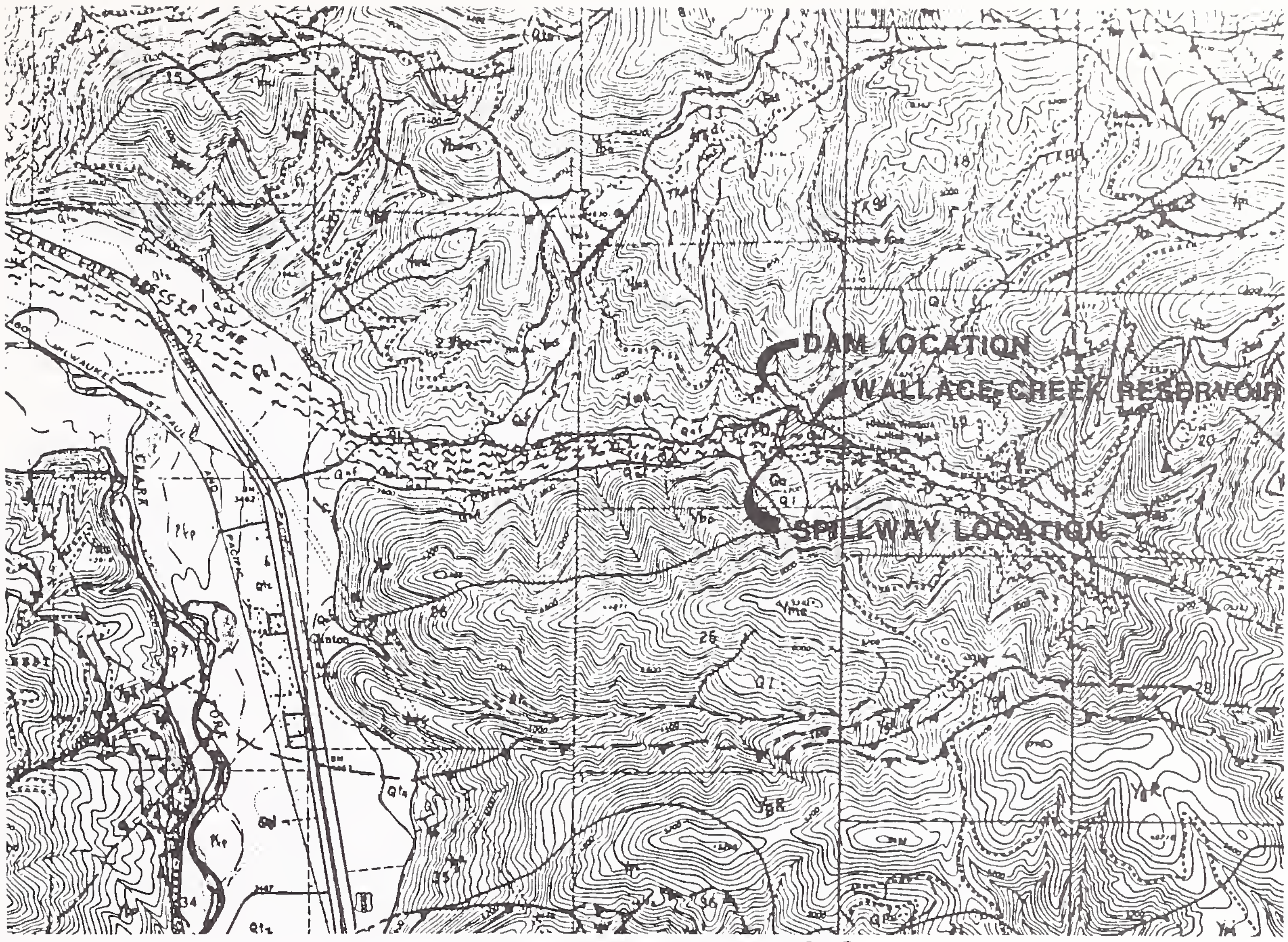


PLATE 6

SPILLWAY ELEVATION - DISCHARGE CURVE



EXPLANATION OF SYMBOLS

PRECAMBRIAN

Missoula Group Rocks

Ypi — PILCHER FORMATION: White to purple, medium- to coarse-grained crossbedded quartzite with small amounts of interbedded argillaceous siltite forming major partings along bedding. Reported range in thickness is 0 to 1500 feet.

Ygr — GARNET RANGE: Red, gray, and green, low-angle crossbedded, blocky micaceous quartzites interbedded with thin-bedded argillites and siltites characterized by 'rip-up' bedding structures and micaceous bedding planes. Thickness of unit is unknown.

Ymc — MCNAMARA FORMATION: Maroon and green argillites and argillaceous siltites interbedded with minor light gray sandstones and quartzites. Upper part of unit mostly red micaceous quartzites intercalated with red micaceous argillite and maroon mud-flake conglomerates. Reported thickness is 2000 feet.

Ybo — BONNER QUARTZITE: Pink to red and purple, thick to massive-bedded, fine- to medium-grained, crossbedded, arkosic quartzite. Reported thickness is 2000 feet.

Yms — MOUNT SHIELDS FORMATION: Lower argillite unit consisting of intercalated light tan siltite and dark red argillite with some lenses of massive siltite up to 50 feet thick.
Middle massive quartzite unit with 3 to 5 foot thick laminated to crossbedded siltites separated by linear argillaceous siltite or soft mud drapes.
Upper unit of interbedded purple siltite and green argillite with minor quartzite. Upper unit easily confused with Snowslip Formation. Thickness unknown.

Cambrian Rocks

Ch — HASMARK FORMATION: Medium gray medium- to thick-bedded dolomite (dolosparite) containing several magnesium limestone zones and, in the upper part, sandy horizons. This formation is from 1200 to 1800 feet thick.

CENOZOIC

Tertiary Rocks

Ta — TRACHYANDESITE PORPHYRY: Light gray microcrystalline volcanic rock matrix containing altered crystals of feldspar minerals. Generally eroded to lava flows which are highly weathered to upper 2 to 3 feet.

Tadi — DACITE PORPHYRY DIKES: Microcrystalline volcanic rocks intruded as planar sheets of rock crosscutting adjacent older rocks and structures

Tkgd — GRANODIORITE: Medium gray, coarsely crystalline homogeneous igneous rock present as large intrusive bodies of stock and batholith size

Alluvial and Colluvial Deposits

Qt / Qt_1 — OLD TERRACE: Constructional or erosional terrace supported by fluvial sediments. Used in preference to Qtg where terrace correlation or distinction between terrace ages is possible. Subscript numeral indicates relative age. Qt is youngest.

Qal / Qal_1 — ALLUVIUM: Stream and river sediments in the valley floors of the Clark Fork and Blackfoot Rivers and their tributaries. Subscripted numerals indicate relative age based on terrace elevations. Qal is youngest.

GEOLOGIC HAZARDS

Alluvial

Qaf — ALLUVIAL FAN: Cone-shaped deposits of alluvium formed where streams issue from steep mountain reaches onto valley floors with less steep gradients and less their sediment transport capacity.

Qdf — DEBRIS FLOW: Recent debris saturated flood material deposited on a debris fan, alluvial fan, or talus cone. Major component of some alluvial fans which often result from intense storm runoff.

pfp — PHYSIOGRAPHIC FLOODPLAIN: Active riverbed and floodplain cover area generally subject to recurring flooding on an estimated 25 year minimum frequency in a state of nature.

Qsw — SWAMP: Area of permanently high ground water, poorly integrated surface drainage, and accumulations of organic material and fine-grained sediments.

Slope Failure

Ql — LANDSLIDE: Collective term applied to several types of slope failure involving downhill movement of rock or surficial debris either as coherent blocks or as mixed earth masses.

Colluvial

Qta — TALUS APRON: Accumulations of coarse, angular rock debris larger than 3 to 4 inches in some dimension at the base of steep slopes and cliffs as a result of bedrock weathering and wasting.

MAPPING SYMBOLS

PUBLIC LAND BOUNDARY

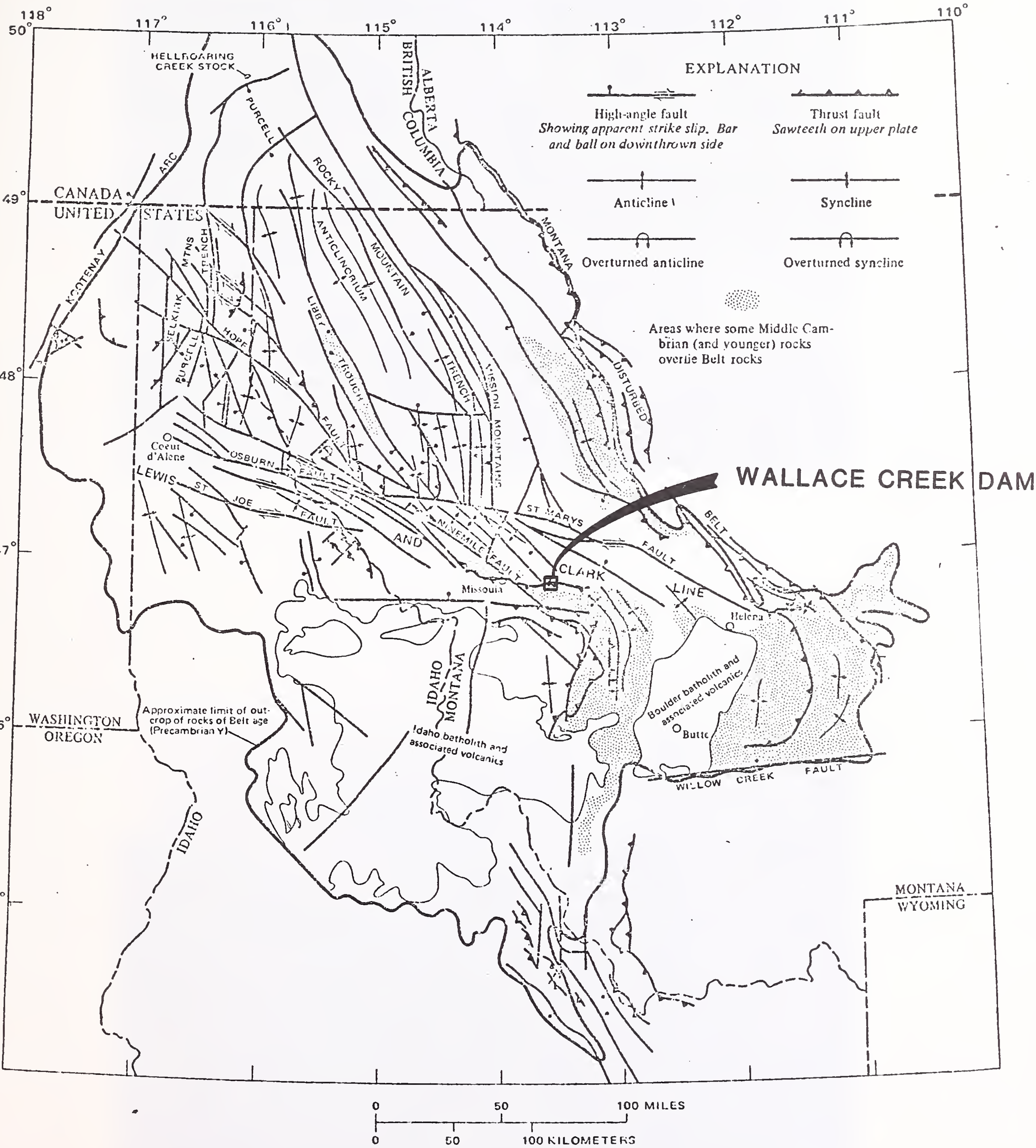
SILICIFIED BRECCIA ZONE

FAULT: Dashed where approximately located, and dotted where covered by younger deposits. Bar and ball on downthrown side.

THRUST FAULT: Dashed where approximately located and dotted where covered by younger deposits. Queried where presence of thrust fault is suggested by stratigraphic information and by prominent trace on air photograph. Sawteeth on upper plate.

SOURCE: GEOLOGIC SURVEY and LAND CLASSIFICATION, BLACKFOOT PLANNING UNIT, GARNET RESOURCES AREA, BUREAU OF LAND MANAGEMENT, 1978.

PLATE 7 GEOLOGIC MAP



SOURCE: USGS PROFESSIONAL PAPER 866

PLATE 8

GEOLOGIC FAULT MAP

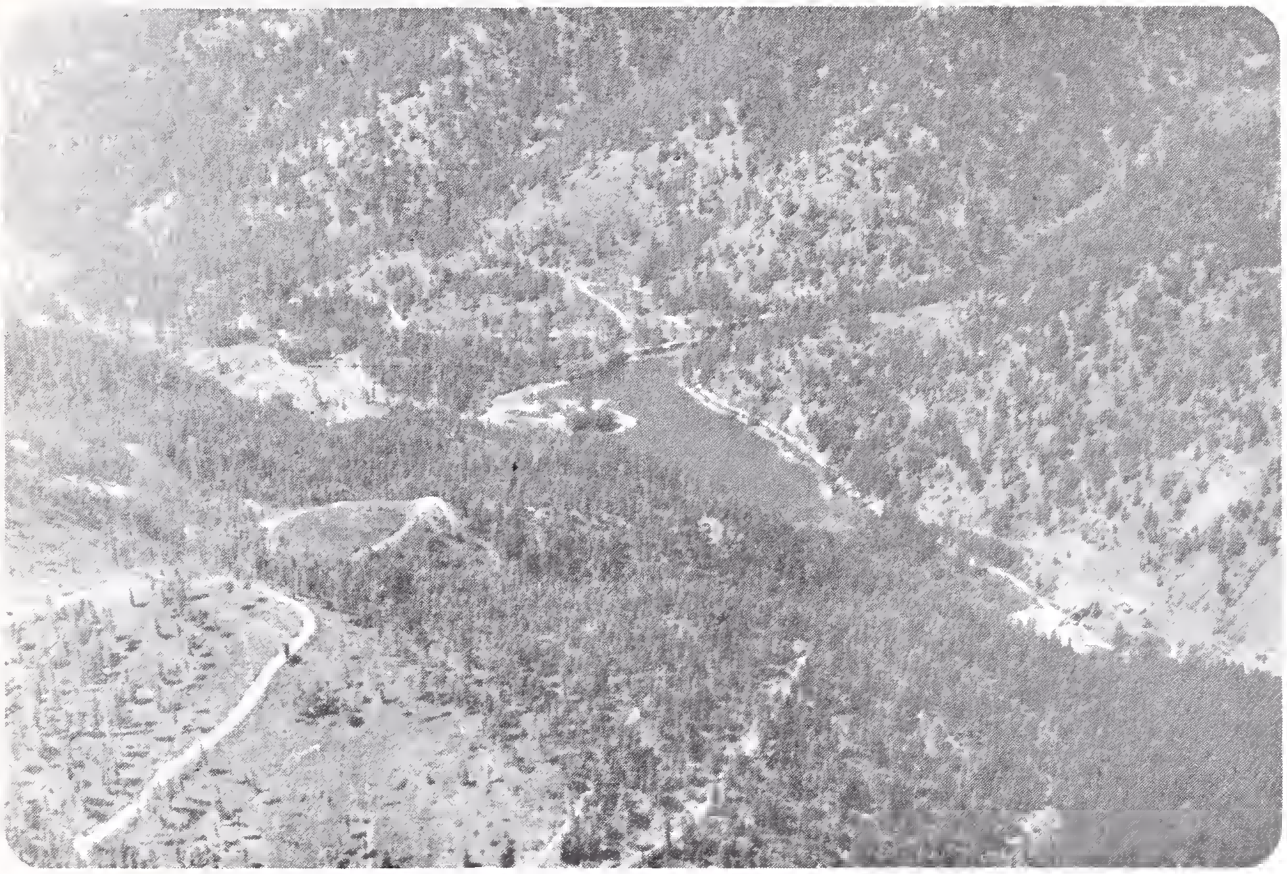


Photo 1   Aerial View of Dam and Reservoir

Photo 2   Aerial View of Dam and Downstream Area to Clinton.

Photo 3 Crest of Main Dam Section from North Abutment.

Photo 4 Crest of Dam at Start of Curved Dike Section Looking South from Main Embankment.

Photo 5 Downstream Face of Main Embankment Area.

Photo 6 Upstream Face of Dam and Dike.

Photo 7 Spillway Entrance.

Photo 8 Spillway Control Section and Discharge Channel.

Photo 9 Spillway Channel Looking Upstream Toward Reservoir From the Control Section.

Photo 10 Spillway Dishcarge Channel Looking Downstream From Seep Area.

Photo 11 Seep Area in Bedrock in Spillway Channel 100 feet Below Control Section.

Photo 12 Location of Wheel Mount for Gate on Crest of Dam.

Photo 13 Outlet at Toe of Embankment. 12-inch Steel Pipe Inside 18-inch Concrete Pipe.

Photo 14 Upper Reservoir and Drainage as Taken from Spillway Entrance.

APPENDIX

Correspondence

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION

TED SCHWINDEN, GOVERNOR

32 SOUTH EWING

STATE OF MONTANA

(406) 449-2872 ADMINISTRATOR
(406) 449-3962 WATER RIGHTS BUREAU
(406) 449-2872 WATER SCIENCES BUREAU
(406) 449-2864 ENGINEERING BUREAU
(406) 449-2872 WATER PLANNING BUREAU

HELENA, MONTANA 59620

March 27, 1981

Department of the Army
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

Attn: Ralph Morrison

Dear Ralph:

Re: Morrison-Maierle, Inc. Dam Safety Inspection Report of Wallace Creek Dam MT-1158.

We have reviewed the above referenced final draft report. We concur with the findings and recommendations and find that it satisfies the criteria of Phase I report.

Minor editorial comments have been discussed with your staff, and we understand these will be incorporated in the final report.

Enclosed is a letter which was sent to us by Flansburg Ranch Co., who owns the dam, concerning actions that they are taking to repair the dam.

Thank you for this opportunity to review and comment on the final draft report on Wallace Creek Dam.

Sincerely,

Richard L. Bondy

Richard L. Bondy, P.E.
Chief, Engineering Bureau

RB:AT:lz

Clinton, Montana,
March 10, 1981

Dept of Natural Resources
& Water Conservation Div.
State of Montana
Helena, Montana 59601

RECEIVED
MAR 11 1981
MONT. DEPT. OF NATURAL
RESOURCES & CONSERVATION

Dear Sirs:—

In regard to the Wallace Creek Dam, we have contacted the Soil Conservation Service in Missoula, to familiarize us with what we have to do, to make this dam safe to pass inspection of all parties involved.

Flansburg Ranch Co.

Yours truly,

Eunice W. Flansburg V.P.
Rex J. Flansburg Sec. Treas.

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION

THOMAS L. JUDGE GOVERNOR

32 SOUTH EWING

STATE OF MONTANA

(406) 449-2872

HELENA, MONTANA 59601

December 30, 1980

Mr. James Flansburg
Clinton, MT 59825

Dear Mr. Flansburg:

On Thursday, July 17, 1980, Wallace Creek Dam was inspected under the National Dam Safety Program by Morrison-Maierle, Inc. under contract with the Department of Natural Resources and Conservation (DNRC). Following the inspection, Morrison Maierle, Inc. completed a first draft report and submitted it to DNRC and Seattle District Corps of Engineers. In this report, Morrison-Maierle, Inc indentified several conditions they felt could endanger the dam and cause potential loss of life and property damage should the dam fail. Based on these observed conditions, Morrison-Maierle, Inc. considers the dam to be unsafe.

The Corps of Engineers sent to us, a letter which expresses their concern for the safety of the dam. A copy is enclosed for your reference.

Major areas of concern are:

1. The reservoir has inadequate storage, and inadequate spillway and outlet capacity to safely store and discharge the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood that may be expected to result from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible for the watershed. The reservoir should be able to route 100% of the PMF, but in the case of your dam, it is able to route 1.5% of the PMF before being overtopped. Overtopping would lead to failure of the dam. Floods of lesser magnitude could overtop and fail the dam if the flood were combined with a high reservoir pool or a plugged spillway or both.

2. There are a large number of trees in the embankment. Trees and roots in embankment structures can cause the dam to fail due to piping of embankment materials along the roots.

3. Lack of a downstream warning plan for use in case of impending dam failure.

Remedial measures that should be implemented until repairs can be made are:

1. Immediately develop and implement a downstream warning plan.

2. Immediately lower the reservoir, and maintain the reservoir at a low level until spillway-outlet capacity can be increased.

3. Immediately enlarge the spillway so that more flood water can be passed in event of a flood of large magnitude.

4. Remove all trees and root systems from the embankment, toe areas and the abutments. All depressions should be backfilled and compacted.

When the report is finalized, other recommendations will be made; but these recommended above are presently considered the most critical to the safety of the dam. The remedial measures are not to be considered as permanent control measures.

If you have any questions, please contact me or Glen McDonald at 449-2864.

Sincerely,

Glen J. McDonald

Richard L. Bondy, P.E.
Chief, Engineering Bureau

RB:AT:lj
enclosure

WRB RV

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX C-3755
SEATTLE, WASHINGTON 98124

NPSEN-FM

1 DEC 1980

Ted Doney, Director
Montana Department of Natural
Resources and Conservation
32 South Ewing
Helena, Montana 59601

Dear Mr. Doney:

Wallace Creek Dam (MT-1158), which is owned by James Flansburg and located approximately 2 miles east of Clinton in Missoula County, was inspected by the engineering consulting firm of Morrison-Maierle Inc., on 17 July 1980. This inspection was under authority of the National Dam Safety Inspection Act, Public Law 92-367, 8 August 1972.

Our review of the first draft inspection report indicates that Wallace Creek is classified as a small size dam which has a high downstream hazard potential (Category 1). Inspection guidelines recommend that the spillway design flood (SDF) for such dams be half the probable maximum flood (PMF) to the full PMF. The PMF is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible in the watershed. The full PMF was used as the SDF due to the number of residences downstream.

A preliminary PMF was developed for this safety analysis. Routing of this estimated PMF through the reservoir shows that the project has the capacity of controlling a flood having a volume approximately equal to 1.5 percent of the PMF. Larger floods would cause overtopping leading to dam failure. Such a failure may cause loss of life and would cause extensive property damage downstream. Based on inspection guidelines, this project has a seriously inadequate spillway and is considered unsafe. We are required to inform the Governor when an unsafe situation is encountered, and this notification to you satisfies that requirement. The DNR & C Dam Safety Office was encouraged to notify the owner of our findings in a telephone conversation 20 November, 1980.

Our final report will contain recommendations for advanced engineering studies and project modifications to bring the project into guideline conformance. In the interim, we recommend the following:

NPSEN-FM
Mr. Ted Doney

1. A downstream emergency warning plan be developed, implemented and tested periodically.

2. Development of an interim reservoir operating plan to minimize risk until improvements are made.

Sincerely yours,

Leon Moraski

LEON K. MORASKI
Colonel, Corps of Engineers
District Engineer

MORRISON-MAIERLE INC
QUALITY ASSURANCE

QA

Project Manager

Branch Manager or Department Head

Peer Reviewer

Principal-In-Charge

Chief Engineer No	Date Approved
81-6	4-20-81

Project No 1447-09-01 (33)